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PATENT APPLICATION

Applicant: Peter J. Janssen, et al.

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Docket: US-010347

Group Art Unit: 2673

Serial No.: 09/920,635

Examiner: Shapiro, Leonid

Title: REDUNDANT COLUMN DRIVE CIRCUITRY FOR IMAGE DISPLAY DEVICE

BRIEF ON APPEAL

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Sir:

The following appeal brief is submitted pursuant to a Notice of Appeal mailed on December 24, 2003 and received by the Patent Office on December 29, 2003.

REAL PARTY IN INTEREST

The real party in interest is the Philips Electronics North America Corporation, a subsidiary of Koninklijke Philips Electronics N.V.

RELATED APPEALS AND INTERFERENCES

No other appeals or interferences that directly affect, or are directly affected by, or have a bearing on the Board's decision in the pending appeal are known to Appellant's legal counsel.

STATUS OF CLAIMS

Claims 1-20 stand rejected. The rejections of claims 1-20 are appealed.

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STATUS OF AMENDMENTS

A "Response under 37 C.F.R. §1.116" was submitted on November 4, 2003 in response to a final office action dated September 10, 2003. No claims were amended in the November 4, 2003 response. Consequently, all claim amendments have been entered.

SUMMARY OF INVENTION

The subject invention relates to liquid crystal displays. More specifically, the subject invention relates to liquid crystal displays (220, see Figure 2) that include means (28) for selectively connecting at least two data lines (220) together to provide image data to pixels 210 of a defective column. Possible defects include defective column lines (220, e.g., a line break) or a defective column driver (230).

Prior art Figure 1 illustrates problems being addressed by the subject invention. As shown, an LCD device 100 includes a plurality of pixels 110; a plurality of column (data) lines 120 that connect to the plurality of pixels 110; a plurality of column (data) drivers 130 that supply data to the pixels 110 via the column lines 120; a plurality of column driver switches 140; a plurality of row (scanning) lines 150 that connect to rows of pixels 110; and a plurality of row drivers 160 that connect to the row lines 120 for selecting a row of pixels 110 to which data from the column drivers 130 is to be applied. Each pixel 110 includes a pixel switching device 112 and a storage (pixel capacitor) 114. The pixel switching device 112, in response to a scanning signal on the connected row line 150, switches a data signal applied via the connected column line 120 into the storage device 114.

Still referring to Figure 1, occasionally, a line defect 170 may occur during the fabrication of a column line 120. Such a line defect 170 prevents a data signal from going to the pixels 110 of column 2 from row numbers 3 to N. Accordingly, the pixels 110 of column 2 from row number 3 to row number N would show up as white or black, depending upon how the LCD device 100 operates. Another possible problem is a defective column driver 130. For example, in FIG. 1, column 4 has a defective column driver 130. In such cases, it is not possible to provide a data signal to any of the pixels

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110 connected to a defective column driver. Accordingly, all pixels 110 of column 4 fail, and the entire column 4 of the display 100 would be permanently white or black.

Referring now to Figures 2-5, the subject invention addresses the foregoing problems by enabling an LCD device (200-500) that can be visually superior to prior art image display systems when one or more column line defects (270-570) and/or failed column drivers (230-530) occurs. The subject image display system includes a plurality of switches (280-580) that are responsive to control signals to selectively connect two of the data lines (220-520) to each other such that image data applied by a data driver is simultaneously applied to at least two data lines or pixels. This causes the pixels that connect to a defective line or line driver to track those of an adjacent line, which tends to visually hide any defect.

For the convenience of the Board of Patent Appeals and Interferences, Appellant's claim 1 (one of the broadest independent claims) is presented below.

1. A liquid crystal display (LCD) device, comprising:

a plurality of pixels arranged in a matrix of rows and columns, each pixel including a pixel switching device having first and second terminals and a control terminal, and a storage device connected to the first terminal of the pixel switching device;

a plurality of data lines connected to the second terminals of the pixel switching devices;

a plurality of data drivers connected to the data lines and providing image data to the data lines;

a plurality of scanning lines connected to the control terminals of the pixel switching devices for selectively connecting the first and second terminals of the pixel switching devices to provide the image data to the storage devices; and

at least one switch responsive to a corresponding control signal to selectively connect two of the data lines to each other such that image data applied by a data driver is simultaneously applied to at least two data lines.

ISSUES

Whether claims 1-3, 7, and 16-19 are patentable under 35 U.S.C. §103(a) over admitted prior art (APA) in view of Haruhiko, JP No. 07-199866 and further in view of Keeney et al. (PUB US 2002/0113766A1).

Whether claims 4-6 and 20 are patentable under 35 U.S.C. §103(a) over APA,

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Haruhiko, and Keeney et al. as aforementioned in claims 1 and 17, and further in view of Lee et al. (US 6,028,442).

Whether claims 8-11 and 13-15 are patentable under 35 U.S.C. §103 over Henley (US Patent No. 5,459,410) in view of Haruhiko and further in view of Keeney et al.

Whether claim 12 is patentable under 35 U.S.C. §103(a) over Henley, Haruhiko, Keeney et al., in view of Lee et al.

GROUPING OF CLAIMS

The rejected claims should be grouped together according to the grounds for rejection: 1-3, 7, and 16-19; 4-6 and 20; 8-11 and 13-15, and 12.

THE REFERENCES

The following references are relied on by the Examiner:

Inventor	Document	Date
Haruhiko	JP No. 07-199866	Aug. 4, 1995
Keeney et al.	US 2002/0113766A1	Aug. 22, 2002
Lee et al.	US 6,028,442	Feb. 22, 2000
Henley	US 5,459,410	Oct. 17, 1995
Applicant's admitted prior art	N/A	N/A

BRIEF DESCRIPTION OF THE REFERENCES

Haruhiko teaches an LCD device in which adjacent data lines are connected together during non-imaging periods for the purpose of reducing power consumption. In particular, Haruhiko teaches an LCD display operated such that adjacent column lines are driven out of phase: when one has a plus voltage the other has a negative

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voltage. Additionally, the drive potential of each column line is reversed in subsequent imaging periods. Thus, lines having one polarity of stored charge, for example +5 volts, have to be charged to another potential, for example -5 volts, before the next imaging period, while adjacent lines having the opposite polarity, (-5 volts) also have to be reversed. To reduce power consumption, adjacent column lines, which are charged to opposite potentials, are shorted together in non-imaging periods. This causes the line charges to neutralize each other, reducing the charge that must be impressed on the lines.

Keeney et al. teaches a technique of repairing an inoperative pixel (or pixels) by disconnecting the defective pixel (or pixels) from its (their) drive(s) and then reconnecting that pixel (or pixels) to another drive (or drives), reference, for example, Keeney et al., paragraph 0037, Figure 1, and Figure 2. To do so, Keeney et al. teaches the use of bypass latches and multiplexers to selectively connect pixels to drive circuitry.

Lee et al. teaches a technique of testing liquid crystal displays by grouping data lines together, shorting them during testing, and then applying a test voltage to the shorted lines. Test pad vias are included to assist testing.

Henley teaches an automatic LCD inspection process in which repairable defects are identified and corrected early in the manufacturing process. Open and shorted lines (columns and rows) are identified by driving the lines. Defects are repaired by depositing conductive material or by laser ablation.

ARGUMENTS

Rejections of Claims 1-3, 7, and 16-19 under 35 U.S.C. §103(a)

The Examiner rejects claims 1-3, 7, and 16-19 under 35 U.S.C. §103(a) over admitted prior art (APA) in view of Haruhiko, JP No. 07-199866 and further in view of Keeney et al. (PUB US 2002/0113766A1). It is submitted that claims 1-3, 7, and 16-19 are allowable over those references when those references and the claims are properly understood.

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Claims 1 and 16, and their dependent claims 2, 3, 7, and 17-19, are allowable under 35 USC § 103(a) at least because one of their features relate to selectively connecting data lines during operation such that image data is simultaneously applied to two data lines. Specifically, the subject application in claim 1 recites:

“at least one switch responsive to a corresponding control signal to selectively connect two of the data lines to each other such that image data applied by a data driver is simultaneously applied to at least two data lines;” [Emphasis added]

and the subject application in claim 16 recites:

means for selectively connecting two column lines to each other such that image data applied by a data driver is simultaneously applied to two data lines. [Emphasis added]

The Examiner asserts that Haruhiko teaches a switch that is responsive to a corresponding control signal to selectively connect two data lines to each other. However, Haruhiko only teaches connecting adjacent data lines together during non-imaging periods, and then only for the purpose of reducing power consumption. As previously noted, Haruhiko teaches an LCD display that is operated such that adjacent column lines are driven out of phase: when one has a plus voltage the other has a negative voltage. Additionally, the drive potential of each column line is reversed in subsequent imaging periods. Thus, lines having one polarity of stored charge, for example +5 volts, have to be charged to another potential, for example -5 volts, before the next imaging period, while adjacent lines having the opposite polarity, (-5 volts) also have to be reversed. To reduce power consumption, adjacent column lines, which are charged to opposite potentials, are shorted together in non-imaging periods.

In contrast, claims 1 and 16 require that image data is selectively and simultaneously applied to two data lines. Such is not taught in or suggested by APA or Haruhiko, either individually or in combination. Indeed, since in Haruhiko adjacent data lines are driven with opposite potentials, to selectively connect adjacent data lines

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together during operation is counter-intuitive.

Keeney et al. teaches repairing an inoperative pixel (or pixels) by disconnecting the pixel (or pixels) from its (their) drive(s) and reconnecting that pixel (or pixels) to another drive (or drives), reference, for example, paragraph 0037, Figure 1, and Figure 2. To that end, Keeney et al. teaches the use of bypass latches and multiplexers to selectively connect pixels to drive circuitry.

However, Keeney et al. does not teach, discuss, disclose, or suggest selectively connecting data lines together such that image data is simultaneously applied to two data lines. In fact, Keeney et al. discloses in paragraph 0034 that defective column lines will render an entire display unusable, and suggests adding spare rows and columns.

Accordingly, allowance of claims 1-3, 7, and 16-19 is respectfully requested.

Rejections of Claims 4-6 and 20 under 35 U.S.C. §103(a)

The Examiner rejects claims 4-6 and 20 under 35 U.S.C. §103(a) over APA, Haruhiko, and Keeney et al. and further in view of Lee et al. (US 6,028,442). It is submitted that claims 4-6 and 20 are allowable over those references when those references and claims are properly understood.

As discussed earlier, APA, Haruhiko, and Keeney et al. do not teach or disclose the invention defined by the independent claims 1 and 16, claim upon which claims 4-6 and 20 depend. Lee et al. does not make up for the deficiencies in those references. Lee et al. teaches testing groups of data lines by shorting numerous data lines together during testing and then applying a test voltage to the shorted lines. However, Lee et al. does not discuss or suggest simultaneously applying image data to two column lines, and does not suggest applying image data from a data driver to two column lines. In contrast, amended claims 1 and 16 relate to image data that is simultaneously applied to two data lines from a data driver.

Thus independent claims 1 and 16 are allowable over the cited references, including Lee et al. Furthermore, claims 4-6 and 20, which depend from those allowable base claims, are also allowable.

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Accordingly, allowance of claims 4-6 and 20 is respectfully requested.

Rejection of Claims 8-11 and 13-15 under 35 U.S.C. §103(a)

The Examiner rejects claims 8-11 and 13-15 under 35 U.S.C. §103 over Henley (US Patent No. 5,459,410) in view of Haruhiko and further in view of Keeney et al. It is submitted that claims 8-11 and 13-15 are allowable over those references when those references and claims are properly understood.

Independent claim 8 recites:

"8. A method of repairing a defect in a liquid crystal display (LCD) device including a plurality of pixels arranged in a matrix of rows and columns, a plurality of column lines connected to the plurality of pixels, a plurality of column drivers connected to the column lines and providing data to the pixels, and a plurality of switches each responsive to a corresponding control signal to selectively connect two column lines to each other, the method comprising:

identifying a defective column in the LCD device, the defective column including a first one of the column lines;

connecting at least one pixel of the defective column to a second by applying a control signal to selectively close a switch such that image data applied to the second column line is applied to the at least one pixel."

[Emphasis added]

Independent claim 8 and its dependent claims 9-11 and 13-15 are allowable under 35 USC § 103(a) at least because claim 8 recites identifying a defective column, and then selectively connecting a pixel of the defective column to a second column such that image data applied to the second column is applied to the pixel.

The teachings of Haruhiko and of Keeney et al. are discussed above. Henley teaches an LCD inspection process in which repairable defects are identified and corrected early in the manufacturing process. Open and shorted lines (columns and rows) are identified repaired by depositing conductive material or by laser ablation.

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In contrast to the invention recited in claim 8, Henley does not teach or suggest connecting a pixel of a defective column to a second column such that image data that is applied to the second column is applied to the pixel. In fact, Henley does not use image data at all. Furthermore, neither Haruhiko nor Keeney et al. teach, disclose, or suggest connecting a pixel of a defective column to a second column such that image data that is applied to the second column is applied to the pixel.

Thus, independent claim 8 is allowable over the cited references. Furthermore, claims 9-11 and 13-15 which depend from claim 8 are also allowable.

Accordingly, allowance of claims 8-11 and 13-15 is respectfully requested.

Rejections of Claim 12 under 35 U.S.C. §103(a)

The Examiner rejects claim 12 under 35 U.S.C. §103(a) over Henley in view of Haruhiko and Keeney et al. an in further view of Lee et al. It is submitted that claim 12 is allowable over those references when those references and claim 12 are properly understood.

Claim 12 depends from claim 8. Claim 8 is allowable because it recites identifying a defective column, and then selectively connecting a pixel of the defective column to a second column such that image data applied to the second column is applied to the pixel. As previously discussed, Henley, Haruhiko and Keeney et al., when taken alone or in any permissible combination, do not teach or suggest the invention recited in claim 8. Furthermore, Lee et al., which teaches testing groups of data lines by shorting numerous data lines together during testing and then applying a test voltage to the shorted lines, does nothing to close the substantial gap between Henley, Haruhiko and Keeney et al. and claim 8.

Accordingly, allowance of claim 12 is respectfully requested.

CONCLUSION

For the reasons advanced above, Appellant respectfully urges that claims 1-20 are patentable. Reversal of all rejections is respectfully requested.

To the extent necessary, a petition for an extension of time under 37 C.F.R.

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1.136 is hereby made. If necessary, please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 20-0782 and please credit any excess fees to such deposit account.

Respectfully submitted,

2/16/04

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APPENDIX OF CLAIMS INVOLVED IN APPEAL

1. A liquid crystal display (LCD) device, comprising:

a plurality of pixels arranged in a matrix of rows and columns, each pixel including a pixel switching device having first and second terminals and a control terminal, and a storage device connected to the first terminal of the pixel switching device;

a plurality of data lines connected to the second terminals of the pixel switching devices;

a plurality of data drivers connected to the data lines and providing image data to the data lines;

a plurality of scanning lines connected to the control terminals of the pixel switching devices for selectively connecting the first and second terminals of the pixel switching devices to provide the image data to the storage devices; and

at least one switch responsive to a corresponding control signal to selectively connect two of the data lines to each other such that image data applied by a data driver is simultaneously applied to at least two data lines.

2 The LCD device of claim 1, wherein each switch comprises a cross-column switch extending between the two data lines selectively connected to each other.

3 The LCD device of claim 2, further comprising a register corresponding to each cross-column switch and providing the control signal for the cross-column switch.

4 The LCD device of claim 1, further comprising a common test line and wherein the at least one switch comprises a column test switch extending between a corresponding one of the data lines and the common test line.

5 The LCD device of claim 4, further comprising a register corresponding to each switch and providing the control signal for the switch.

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6. The LCD device of claim 1 wherein each switch includes a column test switch, the LCD device further comprising:
 - a common test line; and
 - a plurality of common pair selection switches each connected between a pair of the column test switches and the common test line.
7. The LCD device of claim 1, further comprising a register corresponding to each switch and providing the control signal for the switch.
8. A method of repairing a defect in a liquid crystal display (LCD) device including a plurality of pixels arranged in a matrix of rows and columns, a plurality of column lines connected to the plurality of pixels, a plurality of column drivers connected to the column lines and providing data to the pixels, and a plurality of switches each responsive to a corresponding control signal to selectively connect two column lines to each other, the method comprising:
 - identifying a defective column in the LCD device, the defective column including a first one of the column lines;
 - connecting at least one pixel of the defective column to a second by applying a control signal to selectively close a switch such that image data applied to the second column line is applied to the at least one pixel.
9. The method of claim 8, wherein connecting the at least one pixel of the defective column to the second one of the column lines comprises closing a first one of the switches connected to the defective column.
10. The method of claim 9, wherein the LCD device includes a plurality of registers connected to the plurality of switches, the method further comprising storing a data value in one of the registers connected to the first switch to provide a control signal to close the first switch.

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11. The method of claim 8, wherein connecting the at least one pixel of the defective column to the second column line comprises closing one of the switches connected to the defective column and to the second column line.

12. The method of claim 8, wherein connecting the at least one pixel of the defective column to the second column line comprises:

closing a first one of the switches connected to the defective column and to a common test line; and

closing a second one of the switches connected to the second column and to the common test line.

13. The method of claim 8, wherein identifying the defective column comprises identifying a portion of the first column line which is not connected to any of the column drivers.

14. The method of claim 8, wherein identifying the defective column comprises identifying a defective column driver.

15. The method of claim 14, wherein the LCD device includes a plurality of column driver switches each connected to one of the column lines and to one of the column drivers, and a plurality of registers each connected to control terminals of the column driver switches, the method further comprising storing a data value in one of the registers connected to a first one of the column driver switches to provide a control signal to close the first column driver switch.

16. An image display device, comprising:

a plurality of pixels arranged in a matrix;

a plurality of column lines connected to the plurality of pixels;

a plurality of column drivers connected to the column lines and providing data to the pixels; and

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means for selectively connecting two column lines to each other such that image data applied by a data driver is simultaneously applied to two data lines.

17. The device of claim 16, wherein the means for selectively connecting two column lines to each other comprises at least one switch responsive to a control signal to selectively connect the two column lines to each other.

18. The device of claim 17, further comprising a plurality of registers each corresponding to one of the switches and storing a data value indicating whether the corresponding switch should be opened or closed.

19. The device of claim 17, wherein each of the switches comprises a cross-column switch extending between the two column lines selectively connected to each other.

20. The device of claim 17, further comprising a common test line and wherein each of the switches comprises a column test switch extending between a corresponding one of the column lines and the common test line.

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